

USDAFS Inyo National Forest Forest-Wide Invasive Plants Treatment Project

Human Health & Safety Report

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Introduction and Regulatory Framework

This Human Health & Safety report analyzes the potential for adverse health effects in workers and members of the public from the proposed use of eight herbicides (Table 1). Workers include applicators and any other personnel directly involved in the application of herbicides. The public includes forest workers who are not directly involved in herbicide application, and forest visitors who could be exposed through drift of herbicide spray droplets, contact with vegetation, or by eating, or placing in the mouth, food items or other plant materials, such as berries or shoots growing in or near treated areas, by eating game or fish containing herbicide residues, or by drinking water that contains residues. The risk assessment examines the potential health effects on all groups of people who might be exposed to any of the herbicides proposed for use.

Effects to human health were predicted using herbicide risk assessments to characterize the effects of the Proposed Action. The Forest Service contracts with Syracuse Environmental Research Associates, Inc. (SERA) to evaluate human health and ecological effects of herbicides using EPA studies and other peer-reviewed articles from the open scientific literature. The SERA risk assessments are considered the best available science for this project because they disclose effects from the types of chemical application done by the Forest Service, for purposes such as treating noxious weeds as proposed in this document, as opposed to settings such as agriculture. Only herbicides that have SERA risk assessments are proposed in this action.

The Risk Assessments use information from laboratory and field studies of herbicide toxicity, exposure, and environmental fate to estimate the risk of adverse effects to non-target organisms. Table 1 displays the risk assessments for chemical herbicides considered in the EA. Herbicide risk assessments are also available online at <http://www.fs.fed.us/foresthealth/pesticide/risk.shtml> and herbicide labels are available at an EPA maintained website: <https://www.epa.gov/pesticide-labels>.

The risk assessments consider worst-case scenarios including accidental exposures and application at maximum label rates, as well as more likely scenarios using methods, application rates, and protective equipment equivalent to this proposed action. This section includes findings from the SERA reports, based on herbicide application rates proposed for this project, as well as more recent findings when the public raised concerns based on more recent information.

Table 1. Risk Assessments for herbicides considered for use in the Proposed Action

Herbicide (Active Ingredient)	Date Final	Risk Assessment Reference
Aminopyralid	June 28, 2007	SERA TR-052-04-04a
Chlorsulfuron	November 21, 2004	SERA TR 04-43-18-01c
Clethodim	October 30, 2014	SERA TR 056-08-02b
Clopyralid	December 5, 2004	SERA TR 04-43-17-03c
Fluazifop-P-butyl	July 21, 2014	SERA TR-056-07-02a
Glyphosate	March 25, 2011	SERA TR-052-22-03b
Imazapyr	December 16, 2011	SERA TR-052-29-03a
Triclopyr	July 9, 2016	SERA TR-052-25-03c

In addition to the analysis of potential hazards from the active ingredient in the herbicides, the SERA Risk Assessments evaluated available scientific studies of potential hazards of other substances associated with herbicide application, including impurities, metabolites, inert ingredients, and adjuvants. Less toxicity data are usually available for these substances (compared to the herbicide active ingredient) because they are not subject to the extensive testing that is required for the herbicide active ingredients under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), Federal Environmental Pesticide Control Act (FEPCA), and subsequent amendments.

During scoping the public expressed concerns about the use of herbicides and what kinds of effects they may have on human health, including long-term and cumulative effects to humans from the use of herbicides. The public also expressed concerns about whether glyphosate may cause cancer in people, referencing the World Health Organization's International Agency for Research on Cancer (IARC), which identified this herbicide as a probable carcinogen in 2016 (World Health Organization, 2016). This concern is addressed by examining the recent literature and findings of the WHO and other agencies and studies, and analyzing alternatives in terms of the potential for worker/public exposure based on the best available science in the SERA Risk Assessments as well as other relevant scientific research, as discussed in detail below.

Regulatory Framework

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) is administered by the Environmental Protection Agency (EPA) and the appropriate environmental agencies of the respective states. FIFRA requires registration for all herbicides, after extensive testing to evaluate whether a pesticide has the potential to cause adverse effects on humans, wildlife, fish, and plants, including endangered species and non-target organisms, as well as possible contamination of surface water or ground water from leaching, runoff, and spray drift.

When registered, a label is created to instruct the applicator on the proper use of the material and required personal protective equipment. EPA also must approve the language that appears on each pesticide label and the product can only be used legally according to the directions on the label accompanying it at the time of sale.

The Forest Service is authorized by FIFRA and the Cooperative Forestry Assistance Act to use pesticides for multiple-use resource management and maintenance of the quality of the environment as long as the actions comply with the National Environmental Policy Act and the Council on Environmental Quality regulations. Forest Service Manual (FSM 2150) and Forest Service Handbook (FSH 2109) provide direction on safe use of pesticides, including direction on storage and transport, and development of

safety plans and emergency spill plans.

Under the Proposed Action, herbicide use would strictly adhere to label requirements and would be applied by trained and/or certified applicators in accordance with label instructions and applicable federal and state pesticide laws. Applicators would wear required Person Protective Equipment (PPE), to prevent any accidental exposure. Design features associated with the proposed action would provide additional protection from exposure during treatment activities (see DF #s 1-4, 7, 13-15, 36).

Analysis Methods

This analysis utilizes herbicide risk assessments completed by Syracuse Environmental Research Associates, Inc. (SERA). Methods used in the risk assessments are described in detail within those reports and summarized briefly here. Other literature and risk assessments were also used, but the SERA reports were used as the main source of human health and safety risk information because they were created using results of many studies and analyze the effects of the methods used by the Forest Service.

To assess human health risks, the SERA reports compare the dose of herbicide received by a worker or a member of the public under lower, central and upper exposure scenarios with the corresponding herbicide “Reference Dose” (RfD) established by EPA or by the Forest Service/SERA risk assessment for acute and/or chronic exposures. If doses from estimated exposures for a specific Forest Service herbicide application are less than the RfD’s, there would be no indication of a risk of health effects.

RfDs are established by taking the no observable adverse effect level (NOAEL) for each herbicide and then adjusting it to compensate for uncertainty. Most frequently, an RfD is 1/100th of the lowest NOAEL, but it may be even lower in some cases. The RfD is also referred to as the toxicity threshold or threshold of concern. The Hazard Quotient (HQ) is the ratio of the estimated level of exposure compared to the RfD. When a predicted dose is less than the RfD, then the HQ (dose/RfD) is less than 1, and toxic effects are unlikely for that specific herbicide application (i.e., the use is presumably safe). No chemical is studied for all possible effects and the use of data from laboratory animals to estimate hazard or the lack of hazard to humans of other species is an uncertain process. Future findings may change risk values, but this analysis uses the best science available at this time. Thus, prudence dictates that normal and reasonable care should and will be taken in the handling of any chemical, and all applicators are required to wear PPE, and design features have been incorporated to minimize the chance of public exposure to herbicides.

The risk assessments quantify expected exposures and calculate the HQ’s. These estimates provide a range of values (lower, central and upper) rather than relying on a single estimate. The upper exposure estimates are based on the maximum estimate for every exposure factor that is considered, which is very unlikely to occur in forest service operations (e.g., maximum application volume, maximum concentration in field solution, maximum volume of a spill, maximum residue rates on food items, maximum exposure rates, maximum hours worked). The upper exposure estimates are not reflective of the way herbicides would be used in this project and the probability of maximum exposures occurring is very low. Thus, the central and lower estimates provide more realistic risk assessment results and are reported here.

Two of the herbicides proposed in this project (aminopyralid and imazapyr) did not have any HQ values greater than 1, even for the upper estimates. The risk assessments intentionally use extreme scenarios to show the upper levels of possible risks, though they acknowledge that those risks are highly unlikely.

Even considering central or lower HQ estimates, many of the exposure scenarios for the general public

are implausible or extremely conservative. The general public is unlikely to be directly exposed to treated areas because these areas will be posted and because applicators would direct any members of the public to leave the treatment area or delay treatment until the public was no longer present. No people would be directly sprayed.

Estimates of longer-term consumption of contaminated water in the risk assessments are based on estimated application rates throughout a watershed; however, only very small portions of a watershed would be treated. Exposure scenarios based on longer-term consumption of contaminated vegetation assume that an area of edible plants is inadvertently sprayed and that these plants are consumed by a person over a 90-day period. While such inadvertent contamination might occur over a small area, it is extremely unlikely to happen as a result of directed applications (e.g., backpack applications). Even in the case of boom (broadcast) spray operations, which is proposed for some herbicides, the spray is directed at target vegetation and the possibility of inadvertent contamination of cultivated or edible vegetation would be very low. In addition, it is likely that the contaminated plants would have dye on them, and show obvious signs of damage over a relatively short period of time and would therefore not be consumed (SERA 2007). The SERA reports purposely analyze a range of scenarios, with far more exposure than is likely to occur, to ensure that even unlikely potential effects are disclosed.

More recent scientific studies on some herbicides, where available and relevant, were also reviewed and their results incorporated into this analysis. Those references are cited throughout this document.

Project Measures to Protect Human Health

The proposed action includes project design features intended to minimize or eliminate the potential for harmful herbicide exposure to workers and the public. Implementation of the project design features in addition to following label directions will further protect human health. In addition, this project includes low risk application methods and lower risk herbicide formulations.

All herbicides will be applied following label directions, regulations of the California Department of Pesticide Regulation and Nevada Department of Agriculture, Forest Service Manual and Handbook direction, Inyo NF Job Hazard Analyses, and the following requirements included as part of the project description in the EA:

1. Herbicides will be applied by trained and/or certified applicators in accordance with label directions and applicable federal and state pesticide laws, except where the following design features describe more restrictive measures.
2. Weather conditions (wind speed and direction, probability of precipitation, temperature, temperature inversions, atmospheric stability, and humidity) will be carefully monitored before and during herbicide applications to minimize drift, volatilization, and leaching or surface runoff of herbicides, based on label instructions.
3. Prior to the start of spray applications, all spray equipment will be calibrated to ensure accuracy of delivered amounts of herbicide. Equipment will be regularly inspected during herbicide applications to ensure it is in proper working order.
4. Herbicide spray applications will not occur when wind speeds exceed label restrictions. Use best professional judgment and consider application-specific factors (e.g. pesticide and adjuvant properties; application equipment, height, pattern and technique; target vegetation density, size, and

acreage; proximity to sensitive resources; temperature and humidity; and wind speed and direction) to ensure spray applications do not result in unacceptable drift. Prior to beginning spray applications, applicators will be provided with information on local terrain and wind patterns and how they affect spray drift.

In addition to the requirements listed above, design criteria to protect human health include:

7. A spill cleanup kit will be readily available whenever herbicides are transported or stored. Proper Personal Protective Equipment (PPE) would be worn or carried by the applicator at all times when using herbicides.
13. The public will be notified about upcoming herbicide treatments via Forest social media, individual notifications, or posting signs, as applicable. Cautionary signs will be placed at treatment areas and access points prior to initiating treatment when infestations are located near developed/established recreation sites or other high visitation areas. Signs will list herbicides used, target species, application date, and name and phone number of Forest contact.
14. Treatments at special use sites, developed recreation sites, and areas of concentrated public use will be scheduled to avoid weekends and holidays and high use periods of the day. Permittees or Recreation Managers will be notified prior to treatments so that treatments can be scheduled to minimize conflicts.
15. Tribes will be notified of proposed herbicide treatments during the Annual Implementation Process to ensure that plant gathering areas and other sensitive sites are protected. Areas of concern will either be avoided or appropriate treatment measures will be developed in consultation with the tribes.
36. Mixing or application of herbicides will not occur within 100 feet of a well or spring used as a domestic water source. Applicators will be briefed about the locations of domestic water sources prior to beginning work and buffers will be flagged on the ground.

Affected Environment

Many people live near, spend time in, work in, or depend on forest products from the Inyo National Forest. Dispersed and developed recreation areas (trailheads, campgrounds, picnic areas, recreation sites, boat docks and ramps, etc.), traditional gathering sites, and special forest product collection areas can occur near or in the vicinity of invasive plant sites. People engaged in these activities could inadvertently be exposed to herbicides from treatment of invasive plants in or near these areas, and therefore potential effects to the public are analyzed below.

Invasive plant infestations are scattered throughout the Forest. Most infestations are less than one acre, although there are larger areas of some invasive plants, particularly annual grasses such as cheatgrass. Invasive plant treatments on the Forest are typically implemented by Forest Service personnel, but may occasionally be completed by contractors, cooperators and volunteers, or by workers employed by County agencies. The workers are not associated with any particular race or ethnic background; Forest Service workers tend to come from a cross section of the local and non-local community, and many of the forest service staff are made up of seasonal employees from across the country.

Environmental Consequences

Alternative 1 – Proposed Action

Under Alternative 1, label direction and project design criteria would minimize or eliminate the potential for worker and public exposure to hazardous levels of herbicides, based on existing Risk Assessments. No individual worker or public exposures of concern are predicted. The herbicide labels and project design features ensure that herbicides and surfactants are used in rates low enough, or methods selective enough, to avoid exposures above the no observable adverse effect level (NOAEL).

No adverse effects to water sources or public health and safety are predicted. The risk of an accidental spill is not linked in a cause-and-effect relationship to how much treatment of invasive plants is projected for a particular alternative or herbicide; a spill is a random event. A spill could theoretically happen whenever herbicides are transported. The potential risk of human health effects from large herbicide spills into drinking water are mitigated by design features that require mixing away from water sources (DF #6), limits on herbicide use near water (Table 3, EA), and that safety and emergency spill plans be developed as part of all project safety planning (BMP 5.10). Typical applications conducted by the Inyo NF in the past have transported less than a half-gallon of herbicide concentrate in vehicles, often even less (pint or less).

Herbicide Risk Assessment Findings

During the herbicide registration process, the EPA evaluates acute effects as well as carcinogenicity, teratology (birth defects), endocrine-system disruption, and mutagenicity studies of herbicide effects to animals. The study data are used to make inferences relative to human health. Table 2 displays the human health categories based on acute toxicity for proposed herbicides, while Table 3 displays human hazards based on chronic toxicity. Data are from the respective SERA reports and NPIC (2002).

Table 2. Human hazards based on *acute* toxicity categories

Herbicide	Acute Oral Toxicity	Acute Dermal Toxicity	Acute Inhalation Toxicity	Primary Eye Irritation	Primary Skin Irritation
Aminopyralid	Very Low	Very Low	Very Low	Very Low	Very Low
Chlorsulfuron	Very Low	Low	Low	Low	Very Low
Clethodim	Low	Very Low	Very Low	Low	Low
Clopyralid	Very Low	Very Low	Very Low	Moderate	Low
Fluazifop-P-butyl	Low	Low	Low	Very Low	Very Low
Glyphosate	Low	Low	Low	Low	Very Low
Imazapyr	Very Low	Very Low	Low	Low	Very Low
Triclopyr	Low	Low	Low	High	Low

Table 3. Human hazards based on *chronic* toxicity categories

Herbicide	Carcinogen	Teratogen	Reproductive	Mutagen	Endocrine Disruptor
Aminopyralid	Not Likely to Be Carcinogenic	No Effects	No Effects	No Effects	No Evidence
Chlorsulfuron	Evidence of Noncarcinogenicity	No Effects	No Evidence	No Effects	No Evidence

Clethodim	Not Likely to Be Carcinogenic	Unlikely	No effects	No Effects	No Evidence
Clopyralid	Not Likely to Be Carcinogenic	No Effects	No effects	No Effects	No Evidence
Fluazifop-P-butyl	Not Likely to Be Carcinogenic	Teratogen	Some at higher doses	No Effects	No Evidence
Glyphosate	Probable carcinogen (see below for further explanation)	Unlikely	Unlikely	No Effects	Unlikely
Imazapyr	Evidence of Noncarcinogenicity	No Effects	No Effects	No Effects	No Evidence
Triclopyr TEA	Not Classifiable	No Effects	No Effects	No Effects	No Evidence

Note: Not Classifiable = Inadequate evidence of carcinogenicity or for which no data are available; Unlikely = Inconsistent or isolated effects have been shown in laboratory tests, not considered a hazard to humans at expected exposure levels; No Effects = No effects have been shown in laboratory tests; not considered a hazard to humans.

Glyphosate is discussed further here, due to public comments bringing up concerns over human health effects of glyphosate, as well as recent determinations about the cancer risk from glyphosate. Since glyphosate was initially registered in 1974, the carcinogenic potential of the chemical has been evaluated by EPA several times in accordance with the Proposed Guidelines for Carcinogen Risk Assessment (EPA 2016). In 1985, a peer review of glyphosate was conducted and resulted in the agency classifying glyphosate as a Group C chemical (Possible Human Carcinogen), based on the presence of kidney tumors in male mice (Ibid). However, in 1986 the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) conducted another review of glyphosate and determined it should be classified as a Group D chemical classification (Not Classifiable as Human Carcinogenicity) for glyphosate and advised the EPA to conduct further studies in rats and/or mice to clarify the unresolved questions. In 2015, the EPA Classified glyphosate as “Group E - Not Likely to be Carcinogenic to Humans” (CARC, 2015; TXR #0057299).

Currently, glyphosate is undergoing Registration Review by the EPA, a program where all registered pesticides are reviewed at least every 15 years as mandated by FIFRA. As part of this process, the hazard and exposure of glyphosate are being reevaluated to determine its potential risk to human and environmental health. As part of that process, EPA released an issue paper in 2016, reviewing recent studies, and found that, “The available data at this time do not support a carcinogenic process for glyphosate. Overall, animal carcinogenicity and genotoxicity studies were remarkably consistent and did not demonstrate a clear association between glyphosate exposure and outcomes of interest related to carcinogenic potential. In epidemiological studies, there was no evidence of an association between glyphosate exposure and numerous cancer outcomes; however, due to conflicting results and various limitations identified in studies investigating Non Hodgins Lymphoma (NHL), a conclusion regarding the association between glyphosate exposure and risk of NHL cannot be determined based on the available data. Increases in tumor incidence were not considered treatment-related in any of the animal carcinogenicity studies. In 7 of these studies, no tumors were identified for detailed evaluation. In the remaining studies, tumor incidences were not increased at doses <500 mg/kg/day, except for the testicular tumors observed in a single study. Increased tumor incidences at or exceeding the limit dose (≥1000 mg/kg/day) are not considered relevant to human health.”

EPA subsequently released the draft human health and ecological risk assessments for glyphosate on February 28, 2018 including an updated cancer risk assessment for public comment. The agency again

concluded that glyphosate is not likely to be carcinogenic to humans. In addition, the agency found no other meaningful risks to human health when glyphosate is used according to label instructions. These findings are consistent with the conclusions of science reviews conducted by regulatory bodies such as the European Food Safety Agency, the German Federal Institute for Risk Assessment, and the Canadian Pest Management Regulatory Agency (USDA Office of Pest Management Policy 2018).

Again, at the levels proposed in this action, for treatment of small areas of invasive plants, these conclusions do not provide an actual assessment of risk, but instead provide information about the possible hazard of very high doses of glyphosate intake. The SERA report on glyphosate (2011) reviewed many studies, and found that, based on multiple studies, the EPA's 2002 classification of glyphosate as "Group E, No Evidence of Carcinogenicity" appears to be reasonable. However, the SERA report did cite some conflicting studies, again showing that high doses of glyphosate could possibly be associated with increased cancer risk.

In 2017, as part of the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65), glyphosate was added to the list of chemicals in the state of California known to cause cancer. The listing was based on the findings from the World Health Organization's International Agency for Research on Cancer (IARC), which classified glyphosate as "probably carcinogenic" in 2015. The listing does not ban use of the chemical but rather requires that non-government businesses must warn the public of significant exposures including a warning label on all glyphosate herbicides sold in California. Because of that listing, glyphosate is shown as a "probable carcinogen" in Table 3 above. However, as explained below, that rating is based on possible hazard, not actual risk from use of the project as required by label directions.

It is important to note that the IARC classification of glyphosate as "probably carcinogenic" is related to the potential hazard of the chemical rather than the risk. Hazard is different than risk, because a classification of an agent as a carcinogenic hazard indicates that some level of exposure, from occupation, environment, food, or other avenue, could result in an increased risk of cancer (WHO website <http://www.who.int/foodsafety/faq/en/>). Hazard does not suggest that typical exposure is an actual risk to human health. Findings in the recent literature cited above, as well as SERA reports, suggest that with the typical use of glyphosate as proposed in this project, it poses no risk as a carcinogen.

Along with the listing as a probably carcinogen, the California Office of Environmental Health Hazard Assessment (OEHHA) has proposed an Allowable Daily Intake (ADI) of 1,000 micrograms per day per kg of bodyweight for glyphosate ingestion as the "No Significant Risk Level" which is lower than the US EPA ADI of 1,750 micrograms per kg of bodyweight per day. This means that ingesting up to 1,000 (California) or 1,750 (USEPA) micrograms per day is not expected to increase the occurrence of cancer. This project does not propose using herbicides on any food crop that is expected to be ingested by any person, and therefore this project will not add to anyone's intake of glyphosate.

While the IARC and the State of California have concluded that glyphosate is potentially carcinogenic, other organizations have determined that there is not conclusive enough evidence to consider it a risk for cancer at actual levels used in practice. The Joint FAO/WHO Meeting of Pesticide Residue (JMPR) used the IARC findings to help complete a risk assessment of glyphosate in 2016 (WHO 2016), and found that although glyphosate has a hazard rating of 'probably carcinogenic', it is unlikely to cause cancer in people via dietary exposure, even considering its widespread use on food crops. The European Chemicals Agency has also since declared there is no evidence to link glyphosate to cancer or reproductive effects (ECHA 2017).

While there is much public and media discussion about the controversy over potential of carcinogenic

effects of glyphosate on food crops, scientific controversy over levels proposed in this project is not significant. The Inyo NF proposes to use glyphosate in small, targeted areas, on invasive plant species (not food crops) with application possibly occurring for several years in a row at a given site. These amounts are small and studies do not show that this small amount of use, using label directions and PPE for workers, increase the risk of cancer for any person. On the Inyo NF, glyphosate application will typically occur where use of more selective herbicides (e.g. Aminopyralid, Chlorsulfuron, and Triclopyr) is restricted by design criteria.

This project does not propose to treat food crops with any chemical and drift to food crops is highly unlikely using the methods and design features proposed and also owing to the location of the infestations in remote wildlands. Therefore, designations and findings about effects due to chronic high levels of ingestion are generally irrelevant to this project.

Direct and Indirect Effects to Workers

This section focuses on the risks of proposed herbicide application to applicators themselves. Herbicide applicators are more likely than the general public to be exposed to herbicides, and may handle undiluted herbicide concentrate during mixing and loading. In routine broadcast and spot applications, workers may contact and internalize herbicides mainly through exposed skin, but also through the eyes, mouth, nose, or lungs. Worker exposure is influenced by the application rate selected for the herbicide, the number of hours worked per day, the acres treated per hour, and variability in human dermal absorption rates.

All herbicides can cause irritation and damage to the skin and eyes if mishandled. Eye or skin irritation would likely be the only overt effect as a result of mishandling the proposed herbicides. These effects can be minimized or avoided by prudent and required industrial hygiene practices during handling. Worker exposure can be effectively managed through ordinary prudent practices and use of personal protective equipment (PPE) required by law for applicators.

The Risk Assessments summarize risks for backpack and broadcast spraying under normal application and maximum exposures. Exposure levels that were evaluated range from predicted average exposure to worst-case exposure. Risks from accidental/incidental exposures are also evaluated. Backpack spray exposures assume that workers on average treat approximately four acres per day (ranging from 1.5 to 8 acres per day) and broadcast spray exposures assume that workers average 112 acres per day (ranging from 66 to 168 acres per day). For all scenarios, it is assumed that the workers do not receive any protection from exposure provided by clothing, though in reality, applicators do wear personal protective equipment during all applications including long sleeves, pants, socks and shoes, eye protection, and gloves.

Two general types of exposure are modeled: one involving direct contact with a solution of the herbicide and another associated with accidental spills of the herbicide concentrate onto the surface of the skin. Exposure scenarios involving direct contact with herbicide solutions are characterized by immersing unprotected hands for 1 minute or wearing contaminated gloves for 1 hour. Workers are not likely to immerse their hands in herbicide; however, the contamination of gloves or other clothing is possible.

Exposure scenarios involving chemical spills onto the skin are characterized by a spill onto the lower legs as well as a spill onto the hands. In these scenarios, it is assumed that a solution of the chemical is spilled onto a given surface area of skin and that a certain amount of the chemical adheres to the skin.

The maximum application rates allowed per label instructions were evaluated for this EA, though application rates in the field can often be much lower, depending on the species and the method. Most of

the herbicides proposed for use have low potential to harm workers. In most cases, even when maximum rates and upper exposure estimates were considered, hazard quotient values were nearly all below the threshold of concern, with a few exceptions. At the upper exposure estimate, clethodim and fluazifop slightly exceeded the level of concern (HQ=1.3 and 2, respectively) for backpack applications, but could be associated with poor personal hygiene practices during application and assume greater application time and area than are likely in this project. The upper bound for accidental exposure to clethodim for a worker wearing contaminated gloves has an HQ=4; this could easily be mitigated by promptly removing contaminated gloves and washing hands. At the upper exposure estimates, triclopyr exceeds an HQ of 1 for all application methods; however the central estimates of the HQs do not exceed a level of concern for any applications. Most of the risk for triclopyr TEA is due to high risk for eye irritation, which can be mitigated by following proper safety practices and using required PPE.

Direct and Indirect Effects to the Public

The general public is unlikely to be exposed to more than very minor levels of any herbicides used in the implementation of this project. However, to show possible maximum effects, the SERA Risk Assessments considered several exposure scenarios including direct contact, consumption of sprayed vegetation, consumption of drinking water adjacent to a spray operation, and consumption of fish in water adjacent to a spray operation. Accidental exposures including drinking water from a pond contaminated by a large spill were also considered.

Direct Contact: Exposure is quantified from direct spray and contact with sprayed vegetation scenarios. At the maximum application rates proposed in the proposed action, low risk to human health are indicated from direct contact. No scenarios for direct spray or contact with sprayed vegetation resulted in HQs over the threshold of concern. The design features include specific notification and posting requirements for administrative and recreation sites to further reduce the possibility of inadvertent direct spray of a member of the public.

Indirect Contact: Quantitative estimates of exposure were conducted for an adult female swimming for 1 hour in water contaminated by runoff from a treated 10-acre slope. All herbicides had HQs orders of magnitude below a threshold of concern for this scenario, indicating no plausible risk to the public from this exposure. This project will treat few areas over 10 acres, so even this low-risk scenario is very unlikely.

Eating Contaminated Vegetation or Fruit: The public could be exposed to herbicide if they eat contaminated vegetation or fruit that was sprayed, such as berries, mushrooms, or other plants. Directly sprayed plant materials would likely show signs of either dye or herbicide damage, reducing the likelihood they would be consumed. Non-target berries or mushrooms could also be contaminated by drift or uptake from the soil, which would result in lower herbicide residues than direct spraying.

At the central estimate, only triclopyr resulted in a HQ greater than 1 for either acute or chronic exposures from eating contaminated vegetation. For a young woman consuming contaminated vegetation, the upper bound HQ is 27 for acute exposure and 6 for chronic exposure. Consumption of fruit did not exceed an HQ of 1 (SERA 2011c). In the proposed action, triclopyr would only be applied by cut stump, directed foliar spray or wiping. Using these methods, only small areas of vegetation would be treated, and the applicator would be able to spray only target plants, which are not edible vegetation. Therefore, it is extremely unlikely that anyone would consume a substantial amount of this herbicide as a result of the Forest's applications. If an adjacent edible species was accidentally sprayed by drift, it would fall well within the low application rate hazard assessment, which is less than the threshold of concern for human health.

Drinking Contaminated Water: Risks from drinking contaminated water were evaluated for an accidental spill and water contaminated by runoff. The risk assessments also evaluated an accidental exposure scenario where a small child drinks 1 liter of water from a quarter-acre pond, immediately following a spill, into which the contents of a 200-gallon tank that contains herbicide solution is spilled. Although a 200-gallon spill is highly unlikely, it is possible if there were an accident on-site. Applicators usually store, transport and use less than 50 gallons of mixture, even for broadcast application. This amount is not driven on the highways, just mixed and stored on-site for filling smaller tanks on UTVs with booms, or for direct spraying from the truck.

Even with the above unlikely scenario, no herbicides resulted in HQs greater than 1 for drinking contaminated water in either acute or chronic scenarios. All calculated HQs were many orders of magnitude below the threshold of concern, except for clopyralid at the upper exposure bounds (HQ=2), which is highly unlikely to occur in this project as described above.

Consuming Contaminated Fish: Both acute and long-term exposure scenarios involving the consumption of contaminated fish were evaluated using the herbicide concentrations in the contaminated water scenarios described above. Acute exposure was based on the assumption that an angler consumes fish taken from contaminated water shortly after an accidental spill into a pond. Chronic exposures were assumed to occur over a lifetime of eating contaminated fish. People who subsist on fish (for example Native American Indians) could have higher exposure rates than recreational anglers. However, even based on a lifetime of subsistence fish consumption, no HQ values greater than 1 are associated with the herbicide use proposed in any alternative. Therefore, eating contaminated fish is unlikely to affect any human health parameter.

Glyphosate and Cancer: In March 2015, the International Agency for Research on Cancer (IARC) categorized glyphosate as “probably carcinogenic to humans.” The State of California used this information to place glyphosate on its Proposition 65 list as a “probable carcinogen”. This was discussed in detail previously in this document. In summary, the IARC decision was based on studies that found glyphosate may be a possible carcinogen when ingested at a very high dose over a long time period. However, there is likely to be no actual risk to humans based on levels actually used on the ground, even when used on food crops.

In 2016, EPA reviewed over 120 studies conducted on the possible cancer and non-cancer effects of glyphosate. Their review concluded that this body of research does not provide evidence to show that glyphosate causes cancer, and it did not warrant any change in EPA’s cancer classification for glyphosate as not likely to be carcinogenic (EPA 2016).

Glyphosate would be used over small, targeted areas under this project, and would not be sprayed on any crop food or widespread enough to reach a hazard level approaching a threshold of concern. Best available science indicates that glyphosate as proposed for use in this project would not increase anyone’s risk of cancer, either the applicator or the general public.

Endocrine Disruption

The potential for the proposed herbicides to cause endocrine disruption effects was addressed in each risk assessment. The United States Environmental Protection Agency has determined that there is no basis for asserting that aminopyralid would cause adverse effects on the immune system or endocrine function (SERA 2007). No evidence for chlorsulfuron producing direct effects on the endocrine system was found (SERA 2004d). In the review of the mammalian toxicity data on imazapyr, U.S. EPA Office of Pesticide Programs concluded that “there was no evidence of estrogen, androgen and/or thyroid agonistic or antagonistic activity shown.” SERA (2011b) found that this conclusion was reasonable,

based on their review of current information in the 2011 imazapyr risk assessment. None of the EPA/OPP risk assessments or European risk assessments express concern for the potential effects of clethodim on endocrine function (SERA 2014).

The glyphosate risk assessment (SERA 2011a) stated that “some recent studies raise concern that glyphosate and some glyphosate formulations may be able to impact endocrine function through the inhibition of hormone synthesis (Richard et al. 2005; Benachour et al. 2007a, b), binding to hormone receptors (Gasnier et al. 2009), or the alteration of gene expression (Hokanson et al. 2007)” (all references as cited in SERA 2011a). Evaluation of the studies indicates that endocrine disruption effects were indicated for surfactants in the formulations rather than glyphosate itself. No premixed glyphosate formulas are proposed for use. A commercial surfactant would be added to glyphosate when preparing the solution for application, but the surfactant type would be a methylated seed oil/crop oil concentrate, which is typically a corn oil derivative and not implicated in causing endocrine effects. No POEA or NPE based surfactants would be used.

Triclopyr has not undergone evaluation for its potential to interact or interfere with the estrogen, androgen, or thyroid hormone systems (i.e., assessments on hormone availability, hormone receptor binding or post-receptor processing). However, extensive testing in experimental animals provides reasonably strong evidence that triclopyr is not an endocrine disruptor. No epidemiological studies of health outcomes of triclopyr have been reported, and there is no clinical case literature on human triclopyr intoxication. Several long-term experimental studies in dogs, rats, and mice have examined the effects of exposure to triclopyr on endocrine organ morphology, reproductive organ morphology, and reproductive function; treatment-related effects on these endpoints were not observed.

While the potential for the proposed herbicides to cause endocrine disruption effects is not entirely known for all chemicals, the potential for any effects to actually occur are unlikely because of the low apparent risk, the small areas treated, and measures such as required use of proper protective equipment, public notification, use of licensed applicators, training, and limited application rates.

Cumulative Effects

Workers and the public may be exposed to some small amount of herbicides used to treat invasive plants under the proposed action. Cumulative effects are possible within the context of this project, or when combined with herbicide use on adjacent lands or home use by a worker or member of the general public. The potential for cumulative human health effects from any herbicide use proposed in this EA, combined with other potential herbicide applications in the analysis area, would be encompassed in the health risks estimated for chronic exposure scenarios. Chronic (daily exposure for a 90-day period) worker exposure was considered in SERA Risk Assessments and did not result in exceedance of thresholds for any likely scenario.

There is ongoing use of herbicides and other methods to treat invasive plants by other federal, state, and county agencies adjacent to the Forest. Known herbicide use on adjacent lands is expected to pose a similar risk to workers and the public as the herbicide use proposed for this project. However, the potential contribution to cumulative pesticide use by the action alternative is not significant. The generally small and scattered nature of the high-priority infestations on Forest land make it unlikely that exposures exceeding a level of concern would occur from simultaneous herbicide treatments on Forest Service and adjacent lands.

Some of the herbicides proposed for use are also used on food crops, which are consumed by most members of the public, as well as applicators. This is true mainly of glyphosate, which is widely used on

food crops to control weeds. According to the studies cited previously in this document, human ingestion of glyphosate on food crops is unlikely to cause cancer. This project is not expected to result in the ingestion of glyphosate by any person, under the expected application scenarios. Therefore, there would not be cumulative effects when added to regular exposure from dietary intake.

Alternative 2 – No Action

Under Alternative 2, herbicide use would be restricted to herbicides and application methods analyzed and approved under previous NEPA decisions (USDA Forest Service 2007, 2010). These decisions allow the application of chlorsulfuron, glyphosate, imazapyr, and triclopyr, by hand methods only (e.g. painting, wiping, wicking). Potential effects to human health are discussed in the Environmental Analysis for these previous decisions, which are incorporated by reference. Both documents determined that there was a low risk of effect to human health from the proposed herbicide use due to the restrictive application methods and use of required PPE.

References

- ECHA, 2017. European Chemicals Agency. Glyphosate not classified as carcinogen by ECHA. March 2017. Accessed on <https://echa.europa.eu/-/glyphosate-not-classified-as-a-carcinogen-by-echa>.
- EFSA, 2015. European Food Safety Authority. EFSA explains the carcinogenicity assessment of glyphosate. 12 November 2015.
- Forest Service, 2013. Forest Service Manual 2150 – Pesticide Use Management and Coordination. Accessible on website: https://www.fs.fed.us/foresthealth/pesticide/docs/wo_2150.doc.
- Forest Service. 2016. Forest Service Handbook 2109.14 – Pesticide Use Management and Coordination Handbook. Accessible on website: https://www.fs.fed.us/cgi-bin/Directives/get_dirs/fsh?2109.14.
- NPIC. 2002. National Pesticide Information Center 2002 annual report. Accessible on website: <http://npic.orst.edu/reports/NPIC02AR.pdf>
- Syracuse Environmental Research Associates. Mar. 25, 2011a. Glyphosate—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc. Fayetteville, New York 13066-0950.
- Syracuse Environmental Research Associates. Dec. 16, 2011b. Imazapyr—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc. Fayetteville, New York 13066-0950.
- Syracuse Environmental Research Associates. July 9, 2016. Triclopyr—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc. Fayetteville, New York 13066-0950.
- Syracuse Environmental Research Associates. Jun. 28, 2007. Aminopyralid—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc. Fayetteville, New York 13066-0950.

- Syracuse Environmental Research Associates. Dec. 5, 2004a. Clopyralid—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc., 5100 Highbridge Street, Fayetteville, New York 13066-0950.
- Syracuse Environmental Research Associates. Nov. 21, 2004b. Chlorsulfuron—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc., 5100 Highbridge Street, Fayetteville, New York 13066-0950.
- Syracuse Environmental Research Associates. July 21, 2014a. Fluazifop-P-butyl—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc., 5100 Highbridge Street, Fayetteville, New York 13066-0950.
- Syracuse Environmental Research Associates. October 30, 2014b. Clethodim—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc., 5100 Highbridge Street, Fayetteville, New York 13066-0950.
- Syracuse Environmental Research Associates (SERA). 1997a. Effects of surfactants on the toxicity of glyphosate, with specific reference to RODEO®. Fayetteville, NY: SERA; Report TR 97-206-1b.
- Syracuse Environmental Research Associates (SERA). 1997b. Use and assessment of marker dyes used with herbicides. Fayetteville, NY: SERA; Report TR 96-21-07-03b.
- US EPA/ORD. 2000. US Environmental Protection Agency/Office of Research and Development. Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures. Office of Research and Development, US EPA, Washington, DC. EPA/630/R-00/002. Report dated August 2000.
- USEPA. 2016. Glyphosate Issue Paper: Evaluation of Carcinogenic Potential. EPA's Office of Pesticide Programs. September 12, 2016.
- World Health Organization. 2016. Joint FAO/WHO Meeting on Pesticide Residues. Summary Report. Geneva, May 9-13, 2016. Accessed on November 20, 2017 on the website <http://www.who.int/foodsafety/jmprsummary2016.pdf?ua=1>